quite as difficult to get the body out, or more so than if I could only estimate where it was. I think in 75 per cent. of my cases I was unable to see the body, but only estimated its position and in most of those cases I succeeded in getting the foreign body by the magnet.

Dr. J. E. WEEKS of New York—I wish to correct the impression that Dr. Gifford obtained, that I limited the use of the magnet to detecting pieces of steel in the anterior portion of the globe. Experiments made by Haab show that pieces of steel that are encysted will not be affected in the majority of cases except that the contact causes some pain to the patient and as a diagnostic means the magnet serves a good purpose.

The magnet is not portable and consequently is limited somewhat in its usefulness. A case I had a few days ago illustrates this very well. It was necessary to open the sclerotic near the equator of the globe and it was impossible to move the patient to the Haab magnet after this opening was made, because of the fear of producing prolapse of the vitreous humor. In that case the small magnet was used with success.

SHOT-GRAIN WOUNDS OF THE EYE.

Presented to the Section on Ophthalmology, at the Forty-eighth Annual Meeting of the American Medical Association, held at Philadelphia, Pa., June 1–4, 1897.

BY LEWIS H. TAYLOR, M.D.
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It has been my fortune or misfortune to have under my care from time to time, a large number of patients suffering with wounds of the eyeball. Some of these have proven especially interesting to me owing to the serious nature of the injuries and the final results attained by conservative treatment. From among them I desire to present to the Section the histories of a few cases of shot-grain wounds, which I will relate briefly and follow with such remarks on wounds of this character as this brief paper will allow.

Case 1.—E. G., aged 37 years, came in the evening of Nov. 22, 1892, his right eye having been struck about 3 o'clock in the afternoon, by a shot grain from a companion's gun. From his position at the time of the accident the shot had evidently first struck a stone wall and then glanced to the patient's eye. It had passed through the lower lid and entered the globe just inside of the sclerocorneal junction, the iris being partly caught in the wound. The shot could not be seen so I instilled atropia and decided to wait till morning.

On the morning of November 23, the iris being dilated the shot grain could be seen imbedded in the lens and I decided to attempt its removal.

After making a downward section and iridectomy, with combined external and internal manipulation with loop and spatula, I succeeded in dislodging the grain and then removed it with forceps. The eye was bandaged and treated with atropia and boracic acid daily. The reaction was considerable, but this quieted down finally and the lens absorbed leaving a fairly good eye in appearance but with a dense capsule remaining and no useful vision.

In July following (1893) I lacerated this membrane with discission knife, leaving a clear central pupil with vision, in 1895, of 20-c.

Case 2.—G. C., aged 27 years, was out hunting on Nov. 2, 1894, and a stray shot from his companion's gun struck his left eye penetrating the upper lid and entering the eyeball a quarter of an inch above the corneal scleral junction. He entered the Wilkes-Barre Hospital on November 3, and I treated him there until November 24. When I first saw him the anterior chamber was full of blood, iris invisible, and vision entirely gone. The patient was placed in bed, atropia instilled and leeches applied to the temple from time to time. He came to my office November 28, with iris entirely clear, pupil dilated V. 20-cc and fundus partly seen with the ophthalmoscope.

Dec. 24, 1894. Eye now free from irritation and looking well. Pupil still dilated. Ophthalmoscope shows a dark object in the anterior part of the vitreous resting on the floor of the eye, probably the shot grain encapsulated. V. 20-c. The nerve can be partly seen with the ophalmoscope. Some shreds remain in the anterior part of the eye. Now use acid boric, with weak eserin solution.

Feb. 27, 1895. V. in O. S. 20-lxx, some in 20-l. Nerve and vessels quite distinct. Shot still remains in the anterior part of the vitreous back of the lens. With +1, V. = 20-xl.

March 30, 1895. V. = 20-xl with + .50, 20-xxx. Doing well, no pain or inconvenience. There is a slight depression in sclera at the point where the shot entered. In this case, with treatment wholly conservative, the patient recovered with useful vision and saved his eye, which at first appearance decidedly indicated enucleation.

Case 3.—J. T., aged 27 years, came Oct. 26, 1896. He was out gunning the previous afternoon and was shot in the left eye. One grain entered the eyeball a little above and back of the insertion of the internal rectus, but it could not be determined whether this lodged in the eyeball or passed entirely through it. Another shot penetrated the upper lid near the central margin, about three-eighths of an inch above, passed entirely through the lid and probably into the eye though the corneal wound could not be seen. Another passed through the right ear and another under the skin of the right temple for a half an inch.

The lids and conjunctiva were much swollen and blackened with extravasated blood. He was seen on the evening of October 25, the day of the accident, by Dr. Buckman, who instilled atropia and ordered iced compresses to be used through the night. There was now no pain, the pupil dilated, the conjunctiva much swollen but the eye quite comfortable. A clear view of the fundus could not be obtained. There was much cloudiness and evidently blood in the vitreous chamber. He could see a waving hand but could not count fingers at any distance. Here was a serious wound and one in which, owing to danger of subsequent sympathetic ophthalmia, enucleation would probably have been justified. In view of the good result in the previous cases I decided to delay operation and endeavor to save the eyeball even though a sightless one. No effort was made to find the shot. Iced compresses were continued and atropia instilled every three hours.

On October 28, the eye being entirely comfortable and swelling subsiding, the iced compresses were discontinued. Pupil was now dilated but not quite regularly so.

October 31, he reported that in the morning when he first comes to the light the right eye is sensitive, but it soon becomes accustomed to the light and is all right. Patient is not confined to the house but comes to the office daily and his eye is kept bandaged.

November 3. Clearing nicely. Sclera showing. A little blood in anterior chamber.

November 5. Now worse; he went, on the evening of November 3, to be initiated into a lodge and for the first time encountered a bright light. Both eyes congested. Atropia uow used in both and iced compresses applied. This irritation soon subsided and the eye again did well, but on November 16, knowing the possibility of future complications, I advised a consultation and he went to New York, saw Dr. Knapp and remained two weeks under his care. Dr. Knapp agreed as to the possibility of saving his eye and advised delay as to operation, and keeping careful watch as to signs of sympathetic irritation, etc.

I kept him quiet for some weeks, using atropia occasionally. Early in January he went back to his work as mining engineer and reported in the latter part of January, 1897, that he was able to continue his work with the right eye all day without fatigue or inconvenience. There is still no vision in the injured eye, as he merely sees a waving hand. He is entirely comfortable and greatly pleased that the eye was not enucleated, though he was perfectly willing to have it done in the first place had I so advised, rather than run any risk whatever of injury to the other eye.

I saw him recently, May 23, 1897, and the eye was then doing well, V. 20-cc. He can read J. xvi, and the eye seems to be gaining daily. He first noticed that he could see some time last February when out surveying while there was snow on the ground. He is annoyed a little with diplopia, but this is lessening as time goes by.

While thinking of preparing a paper on this subject I have been interested in looking up the literature of similar cases. While not extensive it is certainly suggestive and well worthy the consideration of those who are so ready to enucleate every eye that sustains a serious injury.

Valois (quoted in *Annals of Ophthalmology*, January 1897, p. 193) asserts that, in his experience, shot are among the most frequent of the foreign bodies that by accident penetrate the eyeball; they may enter the globe directly from the gun, or indirectly, after having passed through, or glanced from some other foreign body. "Wounds received from direct

shot are less apt to give trouble than those received indirectly, because, in the latter instance, they may be infected from contact with the reflected body, or the shot may be flattened and so inflict an irregular wound, a condition of things that materially increases the chances for infection after the accident. It is not believed that shot produces the slightest inflammatory action by virtue of any chemic properties of lead; although the vitreous promptly resents the presence of all foreign bodies, it is to be remembered that a shot is tolerated much better than any other extraneous substance."

A very interesting case of gunshot wound of both eyes, studied nine years after the accident, is reported by Dr. Robt. R. Saunders in *Annals of Ophthalmology*, July 1895. In this case one eye recovered full vision while the sight of the other was entirely lost.

Dr. Badal (*Annals d'Oculistique*, January 1895) reports a case in which an eye enucleated on account of shot-grain wound showed upon examination that the shot had crossed the eye and passed out through the sclera of the opposite side and lodged in the orbit. This is the second time he had found a similar condition. He pertinently adds: "I am led to think that hereafter it will be best to wait and not enucleate an eye wounded under similar conditions, as the shot which is lodged in the orbit is in general very well borne and the eye preserves its form and gives no occasion for surgical interference." Dr. Lagrange in discussing the above says: "I have seen a patient with the same conditions as those described. A shot had penetrated the eye and I proposed enucleation, which was refused. Some time after I saw the patient again with the eye in very good condition. In the future I shall be more reserved and wait until enucleation is necessary." Dr. Simon Snell ("Transactions of the Oph. Soc. of the United Kingdom," 1893), reports a case in which a pellet of shot was driven through the eyeball, with retention of perfect sight. "The patient was seen the same day and the question of enucleation delayed to obtain consent of the lad's father. Atropin and iced pads were used. On the following day the eye was doing so well that the question of enucleation was delayed from day to day. The vitreous gradually became clear and it became evident that no foreign body was situated in the interior of the eyeball. It was moreover rendered probable that the pellet which had entered the eyeball through the sclerotic on the inner side had passed out again close to the optic disc on its inner side. Vision further improved within a few days after the accident, and gradually returned to practically normal sight. Nine months after the accident he reads J. 1 readily and V. = 6–6."

T. R. Meux ("Transactions of Tennessee State Medical Society," Nashville, 1896) reports his own case in which the shot entered the eye causing considerable reaction. Several surgeons advised enucleation, but the eye subsequently recovered so that eight and one-half years after, no difference could be distinguished between the two.

Playne ("Oph. Hospital Reports," London, 1858) reports a case in which shot entered the eye causing strabismus and ptosis with subsequent entire recovery.

Dr. Casey A. Wood (*Amer. Jour. Oph.*, 1890) speaking of the comparative danger from shot and other wounds of the eye, such as knife blade, glass, etc., says: "Less likely also is the shot to disturb the ocular membranes, to make a ragged wound, or to remain in the cavity of the globe. It goes through and makes a 'clean' passage. In scleral ruptures and in penetrating wounds made by other agents, the probability of other accidents is also greater than when small shot enters the eye. Among these are dislocation of the lens, retinal detachments, loss of vitreous and extensive intra-ocular hemorrhages. In a word, so far as the eye is concerned, the effects of wounds made by small pistol bullets and the various kinds of bird or buckshot are confined to the tissues through which they immediately pass, while the lesions resulting from scleral ruptures and penetrating wounds of other kinds are far more reaching and destructive in character."

It has seemed to me that shot-grain wounds are really less dangerous than we would naturally expect them to be from the nature and severity of the injuries received, and that in some way these grains are more nearly aseptic than foreign bodies in general. I thought this might be due to the heat generated by the powder explosion, but on examination of an ordinary bird-shot shell I find, covering the powder, a series of wads at least three-fourths of an inch in thickness, so that it is not probable that any of the flame from the powder explosion comes in contact with the shot. The heat developed by the velocity of the shot in passing through the air is thought by many to render the grain aseptic, but Dr. Suter of Herkimer, N. Y., claims to have proven by experiment that the heat developed by bullets during the passage through the air is not sufficient to render them aseptic as is generally stated. He found at least that the bacillus of anthrax would survive the ordeal and infers that it is not safe to consider bullets sterile of the germs.

Tornatola reported (*Arch. für Augenh.*, 491) in twenty-one cases of shot-grain wounds of the eye that he had noticed sympathetic affection necessitating enucleation in only a single case. He attributes this favorable result to the antiseptic treatment of the wound. Shot-grains discharged from a gun were always found aseptic, while those taken in the condition as received from the store and placed in gelatin or bouillon always developed numerous colonies from which he could often isolate the staphylococcus pyogenes albus. In experimental shot-grain wounds in the eyes of rabbits in eight cases out of ten he retained the form and tension of the bulb, provided the eye was disinfected previous to the wounding and treated antiseptically immediately after. On the other hand, in twenty cases wounded in a similar manner, in which there was no attempt at disinfection and no treatment following the wound, there followed fourteen cases of phthisis bulbi, five of panophthalmitis and only a single case which retained its ordinary appearance."

I think we may safely conclude:

1. That shot grain wounds of the eye are less dangerous than wounds of similar severity from many other causes.

2. That in general an eye wounded by shot grains, unless the wound be one of unusual severity, should not be immediately enucleated, but should be treated conservatively under careful observation.

3. A patient with a wound of this character should rest in bed for a period of two weeks or more, and the wound be treated under most rigid antiseptic precautions.

Additional interesting cases bearing on this subject may be found as follows:

John Butler: London Med. Gaz., xiii, 1888.
Arthur Benson: British Medical Journal, 1882, ii, 1085.
J. W. Southworth: Buffalo Medical and Surgical Journal, 1872-3, xii, 9-10.
Wm. Caston: Texas Medical Journal, 1887-8, iii, 311-314.
A. Poland: Oph. Hosp. Reports, London, 1858, i, 214.
White Cooper: London Jour. Med., 1851, iii, 969-976.
E. Willmer Phillips: Lancet, London, 1888, i, 1071.

DISCUSSION.

Dr. C. W. KOLLOCK of Charleston, S. C.—I believe there are many eyes wounded by shot grain in which it is useless to enucleate because the shot has passed through the eye. In one case I saw, the shot passed directly through the ciliary body and then out into the orbit. I had the pleasure of examining this eye four or five years afterward and there was no trouble with the eye.

Another point in these cases is that those cases in which the shot passes through the cornea without wounding the lids, if they remain in the eye there is not apt to be any ecchymosis of the lids. If the shot has passed through into the orbit there will be. That I believe to be a diagnostic point.

Dr. C. A. WOOD of Chicago—Some years ago I reported a series of these cases in the *American Journal of Ophthalmology* and I came to nearly the same conclusions as Dr. Taylor has. I then advanced the idea that shot grains were probably aseptic at the time of penetrating the eyeball. It seemed to me the friction of the shot grains in passing through the air rendered them sufficiently aseptic to account for the condition that occurs after the trauma. I think that has much to do with the favorable results obtained after injuries of this sort.

Dr. ROBERT L. RANDOLPH of Baltimore—I think that Dr. Wood has suggested the probable explanation of this matter. Some few years ago Dr. La Garde of the U. S. Army made some experiments with regard to the infectiousness of gunshot wounds. He stood at varying distances from culture media and fired into the media with pistol and rifle. In the majority of cases he obtained negative results, that is to say the test showed that the bullet was aseptic. The aseptic condition of the bullet then would explain the comparative freedom from disastrous results after gunshot wounds.

Dr. HAROLD GIFFORD of Omaha—I would remind Dr. Randolph that the experiments referred to also gave a number of positive results and that the conditions surrounding the ordinary bird shot are not so favorable as those surrounding the bullet. You have not the chance of the flame and heat of explosion coming into contact with the shot as with the bullet in the smooth-bore rifle. The chemic properties are probably more important than the aseptic properties.

Dr. L. H. TAYLOR of Wilkes-Barre—I thought they were rendered aseptic by contact with the flame, but on examining the shells, I found them covered by a dense covering three fourths of an inch in thickness, so I conclude that the flame has little to do with it, but friction in passing through the air may have much to do with it.

IN WHAT CASES AND WHEN TO ENUCLEATE IN INJURIES OF THE EYE.

Presented in the Section on Ophthalmology at the Forty-eighth Annual Meeting of the American Medical Association held at Philadelphia, Pa., June 1-4, 1897.

BY JOHN M. FOSTER, M.D.
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There is probably no class of cases that fall to our care that give us the same amount of anxiety and solicitude as to the probable and possible outcome, as that which occurs in the injuries, especially in the penetrating wounds, of the eye. The experience of years and a large number of cases does not enable us to say with any degree of precision, this case will have sympathetic ophthalmia, or panophthalmitis, or that that case will not. We know that in a certain class of accidents, especially in those where there has been deep, penetrating wounds, more particularly in the ciliary region, serious results are liable to follow, and they often do. But, on the other hand, how frequently we note the termination of these unfavorably appearing cases in kindly healing, without the slightest untoward symptom; no irritation of the fellow eye, and even a better result in the injured one than we had any expectation of seeing.

It is precisely this uncertainty, and the dreadful consequences that are liable to follow these injuries, that lends this subject an intense and continuous interest, giving it a respectful hearing at all times. If we could feel sure that any age, sex or condition gave an injured eye exemption from the liability of affecting its mate, we could have the comfort of feeling secure in at least a small percentage of our cases, but unfortunately we know of no such exemption. Our clinical experience has not given us such assurance, but, on the contrary, has shown beyond doubt that age, at least, has a bearing and not a favorable one; for we have ascertained that children under the age of puberty are more prone to sympathetic ophthalmia after injuries, than at any other period of life. We have not been able to go further, however, and determine any time at which there is any degree of immunity. The question is not the amount of safety age affords, but one that asks us at what age we feel the most anxiety.

Naturally, the first point of interest in any accident to the eye would be the character, and, secondly, the location of the injury or wound, affecting as they do our prognosis and treatment to such an extent, as is hardly the case in any other part of the body. Slight superficial injuries, such as are produced by blows with the fist or a dull instrument, causing contusions and bruisings of the coverings and appendages of the eye without solution of continuity of the ball itself, while they frequently are productive of serious or fatal results to vision, are in the rarest of instances followed by sympathetic affection of the uninjured member. Indeed, so seldom do we find even a sympathetic irritation from this class of injuries that we content ourselves by bearing in mind the possibility of a complication, and concentrate our attention upon the alleviation and betterment of the injured eye. Under these circumstances, that is, with no pain, irritation or photophobia, we would hardly give the subject of enucleation serious consideration, bearing in mind also the large number of even severe injuries of the eye that are not followed by sympathetic ophthalmia; only two occurred in something like six hundred cases, thus allowing us to discard a large percentage of cases from the subject in hand.

It is a far different matter, however, when we deal with a penetrating or poisoned wound, even if the instrument or particle producing it is *not* left in the globe. Its presence, nevertheless, adds that much more to the gravity of the case; while a demonstration of its absence, which is not always an easy matter, does not give a sense of relief or a feeling of security. In any event, we have a serious condition before us, which is influenced by several factors, viz., depth, position and character of the wound, as well as the presence or absence of a foreign body. All serious questions, demanding serious consideration.

Our prognosis and method of procedure will be modified or entirely changed oftentimes by the position of the wound almost alone; that is to say, when we find a gaping, lacerated wound in the region of the ciliary process, we consider the case very much more serious and more likely to demand stringent proceedings than if it is in the conjunctiva somewhat remote from this situation. We can, I feel, be governed by the following: All things considered, a wound in the ciliary region more often demands enucleation than in any other locality, and that we should not hesitate in these special cases to do the operation if there is